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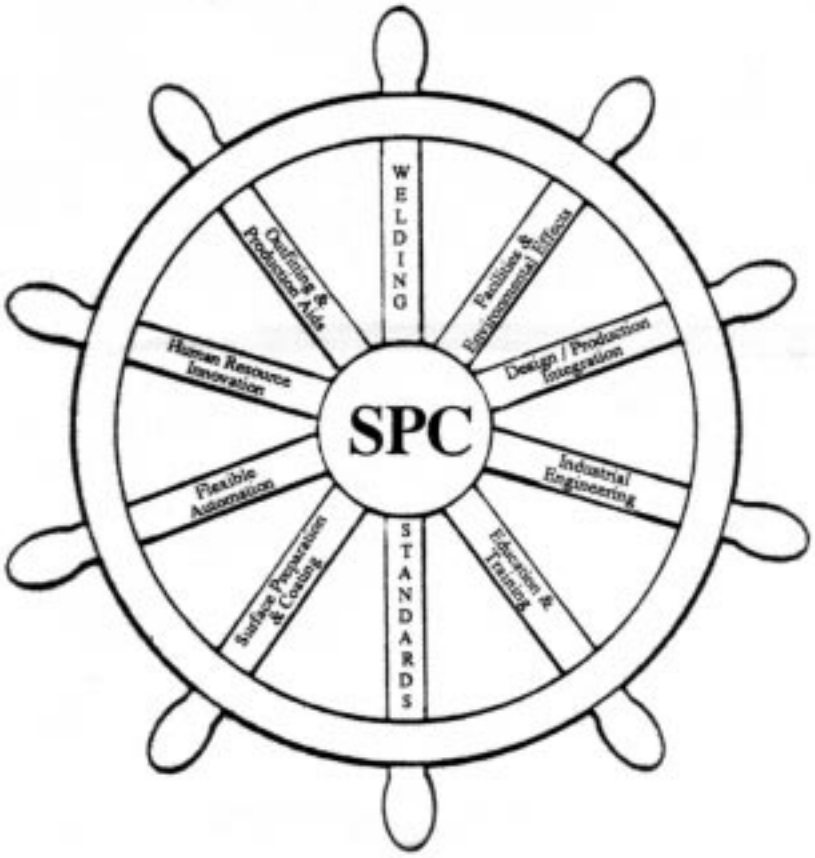

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The Path to U.S. Shipbuilding Excellence- Remaking the U.S. into a World Class Competitive Shipbuilding Nation

8A-2

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ABSTRACT

U.S. shipbuilding has a unique opportunity now to reenter and compete profitably in world commercial shipbuilding. World shipbuilding demand is expanding rapidly and U.S. costs of most factors or inputs of production are today comparable to those of major shipbuilding countries. A path for regaining a U.S. commercial shipbuilding competitiveness is described and formal steps suggested which will be necessary to remake the U.S. into a world class shipbuilding nation.

Many of the proposed steps will be painful, but similar steps have been taken by other U.S. industries, such as manufacturers of automobiles, steel, construction, electronics, and appliances. They are deemed necessary if U.S. shipbuilding is to survive as a viable industry under conditions of declining defense budgets, consistent federal budget deficits, and increasing importance of trade to the U.S. economy.

INTRODUCTION

While the U.S. flag fleet maintained its size in both absolute (tonnage) and relative terms (as a percent of world fleet size) at about 17 million GRT (25.2 million DWT) or about 4.9% of world total in 1989, over 25% of that tonnage and 285 out of 681 ships in the U.S. flag fleet are "inactive" and generally obsolete vessels.

out of 390 privately owned vessels with a tonnage of 18.645 m DWT, only 167 (with 7.06 m DWT) serve foreign trade.The average age of the active U.S. flag fleet is in excess of 16.45 years, with a foreign going fleet age average of 11.4 years and a domestic fleet age average in excess of 19.2 years. The average age of "inactive" ships is estimated to be in excess of 28.8 years. The U.S. merchant fleet therefore competes with fleets of countries like Turkey, Thailand,and the Philippines for laurels of oldest fleet of merchant ships.

STATUS OF U.S. SHIPBUILDING

The volume of U.S. commercial shipbuilding as a percentage of world shipbuilding output in GRT has fallen from 8.4% in 1974 to zero percent in 1988 and 1989, as shown in Table 1. This trend will continue at least to 1991, after which at least one containership will be delivered.The major hope for the industry is now the required rebuilding (or life extension) of the U.S. cabotage fleet, which is now larger than the U.S. flag foreign going fleet in both numbers of vessels and GRT.

Table 1 - Volumes of Newbuilding Orders Accepted and Order Book at American Shipyards (100 GT and above)

	Orders Accepted			Shipyard Order Book (End March)		
Year	1,000	GT	%	1,000	GT	%
1970	543		1.9			
1971	871		2.9			
1972	1,316*		4.4	2,149		2.6
1973	2,131*		2.9	3,104		3.1
1974	2,122*		8.4	4,533		3.4
1975	4.8		5,383			4.7
1976	647		4.9	4,897		6.5
1977	137		1.2	4,640		9.0
1978	377	455	4.6	2,335		9.9
1980	714		3.7	1,578		5.1
1981	210		1.2	1,700		4.8
1982	205		1.1	691		2.4
1984	274		1.8	379		1.2
1985	20		0.2	516		1.7
1986	2	2	x 10^{-4}	316		1.3
1987	4	3	x 10^{-4}	189		0.9
1988	0	0		24		0.1
1989	0	0		0	0	

* Increased sharply due to strengthened Construction Differential Subsidy (CDS).

Note: Percentage figures (%) indicate the share of world total.

Source: Lloyd's statistics.

U.S. flag shipping firms continue to aggressively order in foreign shipyards. During the period` 1986-1987, three U.S. flag operators (American president Lines (APL). - since defunct), and Lykes ordered 30 containerships with a combined value of $1.381 billion.

U.S. owners (U.S. and FOC registry) ordered a total of 59 vessels in foreign yards between January 1987 and December 1989, with a tonnage of over 4.3 million DWT. These orders constituted 11.7%, 6.5%, and 4.4% of the world orders placed in these three years. U.S. owners therefore proved astute in replacing tonnage in 1986 and 1987, when newbuilding prices were comparatively low, at a rate nearly 60% above their proportional ownership of average tonnage. As a result, many U.S. owners are expected to benefit from lower financial costs of their fleets for years to come.

Considering commercial newbuildings completed (100 GRT plus), U.S. shipbuilding output reached a peak of 1.352 m GRT in 1979 which, at that time, constituted 9.5% of world output. Since then U.S. commercial shipbuilding output has plummeted to near zero. At the same time newbuilding orders for naval vessels increased from 6, with a value of $758 m in 1970, to 32 with a value of $9.886 m in 1988, as shown in Table 2.

Table 2 - Amounts of Newbuilding Orders for Navy Warships Contracted by American Shipyards (Unit: US$ million)

Year	Number of Vessels	Amount
1970	6	758
1975	16	1,677
1980	28	1,934
1981		2,842
1982	28	7,777
1983	27	5,041
1984	11	2,849
1985	11	1,679
1986	16	3,035
1987		3,522
1988	32	9,886

The actual number of deliveries of vessels by U.S. shipbuilders is shown in Table 3, which also indicates the gradual decline of shipbuilding revenues.

Shipbuilding employment in the U.S. on the other hand increased between 1976 and 1981 from 166,300 total (132,100 production sector) to 178,900 total (142,200 production sector) or by about 7%. It has since fallen by 111,000 and 82,500 respectively in 1988 or by nearly 33%.

During the same period (1976-1988) Japanese Western European shipbuilding employment fell by 78% and 71% respectively, while output in GRT fell by 55% and 61% during the same periods. At the same time, the average ship constructed has become significantly more complex and expensive. In value added terms Japanese shipyards increased their contribution per manhour three fold, versus a European increase which doubled value added between 1976 and 1988. Such measures of productivity are rather tenuous and are difficult to apply, particularly when shipyards produce different outputs and operate under different client imposed conditions.

Table 3 - Number of Deliveries by U.S. Shipyards

Year	Revenues ($ Million)	Number Of Ships: Merchant ships of 100 GT and above	Warships of 1,000 tons and above	USCG & Others
1983	9.49	12	80	12
1984	9.64	13		9
1985	9.48	8	76	9
1986	8.91	9		7
1987	8.72	1	77	5
1988	8.75	0	86	3
1989 •	8.66	0	↘	↘

• Estimated.

Note: Public-owned shipyards not included.
Source: MARAD

SHIPBUILDING COSTS

While the U.S. used to have the highest shipbuilding worker costs, this is no longer true. As shown in Table 4, U.S. shipbuilding wages are now lower than those of major shipbuilding countries such as Japan, West Germany, Finland, Holland, Norway, Denmark, and Italy, and about equal to those of France.

Table 4 - Trends in Comparative Wages of Shipbuilding Workers (Unit: US$/H)

country	1977	1980	1988	1989.
U.S.	8.08	11.94	14.82	15.64
Japan	5.11	6.77	14.59	15.82
West Germany	8.88	14.25	20.82	21.94
U.K.	3.64	7.58	9.91	10.90
Netherlands	8.63	12.69		15.92
Finland		–	15.95	17.04
Sweden	9.76	13.22		
Norway	9.20	11.97	19.96	21.80
Denmark	8.01	11.33	16.99	17.85
France	6.44	10.73	14.51	15.48
Italy	5.55	9.10	14.59	15.64
Spain	4.41	7.13		8.80
Taiwan	0.91	1.86	4.38	5.64
South Korea	1.40	1.72	4.31	5.98

• Author's personal inquiry.

Source: The U.S. Shipbuilding Industry', by C. H. Whitehurst, excepting the figures for 1988 taken from ISL's Shipping Statistics'.

British and Spanish wage costs are still significantlv lower. Taiwanese and Korean wage-costs are now about 38% of U.S. costs, up from 22.8% in 1982, and rapidly gaining as wages in those countries are escalating at nearly 20% per year now.

Material and service costs differ quite significantlv among shipyards; both within the U.S. and among U.S. and foreign shipyards in general. For example, U.S. Gulf Coast yards usually experience a 6% cost advantage in material and service costs over U.S. Atlantic and Pacific Coast yards. International shipbuilding material cost differences are much larger. Much of the cost differentials appear to be more a function of methods and procedures used in procurement than base material (such as steel) costs in different shipbuilding countries.

Shipbuilding steel prices, for example, differ bv onlv 6% for the same-quality and Quantity purchases of different shipbuilding steel plate and by less than 11% for shapes among various steel producing shipbuilding countries, such as the U.S., Spain, West Germany, Japan, and Korea. Similarly, shipbuilding outfit equipment, machinery, and material cost differences are comparatively small among the above mentioned countries.

Wages presented in Table 4 only represent a part of total labor costs which also include:

1. social benefit - such as health, pension, etc.;
2. training;
   bonus for profit sharing;
3. vacation; and,
5. relocation and hiring/firing.

While U.S. shipyards spend significantly more on social benefits (mainly health) and relocation, hiring/firing, and related costs, the Japanese builders, most Japanese yards have bonuses and more extensive training costs. Non-direct wage costs in the U.S. are about 38% of direct wage costs, while they average well over 56% for Japanese yards. (This number is subject to fluctuations as bonuses vary from year to year.)

In general, we found that the cost of the principal factor inputs, such as labor, steel, equipment, outfit materials, machinery, etc., have little significant variation among Western European, Japanese, and U.S. shipbuilding, with higher total wage or labor costs often balanced by lower material input costs. A recent study for a foreign shipbuilder actually indicates that, with similar expenditures in production manhours and overhead, most commercial vessels could be competitively built in the U.S. (In fact, at a cost about 5% below the cost of an equivalent vessel built in a typical Japanese yard.)

U.S. SHIPBUILDING TECHNOLOGY

Since 1970 all major U.S. shipyards have been extensively rebuilt and/or reequipped. Most of these yards have installed advanced material handling, steel cutting and forming, welding and other process technology. The U.S. shipbuilding industry has been extensively involved in the development of computer-aided design and manufacturing and has recently introduced various advanced manufacturing management and control technologies.

Lack of access to cr availability of technology is therefore not the reason for the continued lack of improvements in U.S. shipbuilding competitiveness and productivity. Labor productivity in terms of manhours per unit of output is only 40% of that achieved in Japan, and 82% of that of Korean yards. U.S. shipyard overhead costs, which include administration, inventory, underutilization, and other costs, are significantly higher than those of comparable yards abroad even though most U.S. yards have access to advanced manufacturing management technology such as Materials Requirement Planning (MRP), scheduling, and other systems, and most basic advances in expert systems of potential use to shipbuilding originated in the U.S.

WINDOWS OF OPPORTUNITY FOR U.S. SHIPBUILDING

We are now entering a period of increasing demand for newbuildings (or vessel life extension) as the world shipping supply/demand balance continues to shrink in all types of shipping and few, if any, new large vessel shipbuilding capacity is under development anywhere.

At the same time world trade has and will continue to become freer with new and longer trade routes opening up all the time. Foreign trade with Eastern Europe and the U.S.S.R. alone is expected to add over half a billion tons or 12% to seaborne trade over the next 8 years.

Currently used foreign shipbuilding capacity in Japan, Korea, Western Europe, Taiwan, etc., is

barely able to satisfy ship replacement requirements. In fact, by 1992, the only underutilized large ship shipbuilding capacity will be in the U.S. At the same time, shipbuilding input or factor costs in the U.S. will be as low or lower than those of other major shipbuilding countries. This provides a unique opportunity for U.S. shipbuilding to reenter international commercial shipbuilding. This opportunity, though, will not last.

To take advantage of it will require a radical change in the way U.S. shipbuilding is organized, managed, operated, and does business, including the way it markets its products and procures its inputs. It requires learning from the past and designing for the future, and focusing on shipbuilding as an integral manufacturing system. Piecewise technology adoption to solve narrow or parochial problems so prevalent in the recent past have often caused new and sometimes more serious problems. This approach must be replaced by new collaborative methods in which product and process technology is developed and effectively used by cooperation among clients, shipbuilders, workers, suppliers, and government or regulators.

This will require breaking down of barriers of mistrust which invariably led to adversarial relationships between:

clients and shipbuilders;
shipbuilders and suppliers;
shipbuilders and regulators; and,
shipbuilding management and workers.

It is important that all parties are involved and/or considered in product and process developments.

Most essential is the improvement of U.S. shipbuilding productivity. As shown in Table 5, an average U.S. yard requires 2.31 as many manhours of direct production labor and 2.3 times as much time to deliver the first of a standard 80,000 DWT tanker as a typical Japanese shipyard. There is simply no justification for this discrepancy. In fact, if larger indirect manhours, including external design costs, are included, the manhour differential jumps from 2.31 to over 2.68.

CAUSES OF LOW U.S. SHIPBUILDING PRODUCTIVITY

Productivity in U.S. yards is affected by several historic, institutional, and structural factors.

Casual methods of hiring and firing of production or hourly labor are a historic anomaly which has no place in modern shipbuilding, in which the vast majority of the workforce must be highly skilled and trained to operate particular and often sophisticated machinery or processes.

Table 5 - Comparison Of Productivity

(Base line Of 1.0 for Japan, unless otherwise Specified.)

Item	U.S.	Japan
Ships	(In the Case Of construction Of five 80,000 DWT Class tankers)	
Area of Plant	2.5	1.0
Travel distance Of materials	5.0	1.0
Number of built-up blocks	209	250
Period required for delivery Of the first Ship (after contract)	140 weeks	60 weeks
Manhours	2,374000 H (2.31)	594,000 (1.0)

U.S. superior points: Outfit, piping Construction
U.S. Inferior Points: designing techniques, Casting techniques, production Control

Source: U.S. Maritime Administration

To be productive, such a workforce should be permanently employed, with unskilled or lower skilled labor hired through contractors. Labor turnover in U.S. yards is many times that of Japanese, Korean, and European yards. It has always been significantly higher (by a factor of 3-4) even during times of fairly steady shipyard employment. (Hiring and firing contribute significantly to overhead costs and reduce productivity as new hires or workers under notice will not achieve their normal productivity).

A related issue is the quality of the existing workforce. U.S. shipyard workers are, on average, older (37.8 years) and less educated than in other major shipbuilding countries. Although 73% have finished high school, basically none have college education, even among production foremen and floor managers. Very few have the basic statistical skills required for effective quality control and a significant percentage are functionally illiterate, even among high school graduates. Yard-provided training is usually confined to narrow skill enhancement and not education.

Another important issue is labor-management relations which are often adversarial. Effective mutual communication required for effective operations is often lacking, nor do labor and management recognize mutually beneficial objectives. The

strong role of unions is a major factor. Shipbuilding unions have, for example, opposed job security or permanency, as it would deprive union leadership from using seniority as a power plan. This in turn results in newly hired highly skilled workers to be laid off before older less skilled workers.

Also, proliferation of unions (often more than 7 unions organize labor in a U.S. yard) results in destructive restrictive job definition which reduces management's ability to use labor productively.

Unions also often obstruct introduction of new technology and require workers to be relegated to task oriented labor. Similarly, communication barriers among labor and management and their induced conflicting interests stymie effective feedback from the shop floor, something which is essential for productivity improvements.

Shipbuilding unions are among the last narrowly organized craft type unions in the U.S. Their organization, work rules, and skill or job definitions are out of line with actual work requirements in today's shipbuilding.

As a result, new technology is not always effectively operated. It also causes insufficient cooperation among people using technologies or processes which only perform well if effectively integrated. Shipyard process innovation and technology adoption (both hard and soft) appears to be random and mostly motivated by individuals interested in specific areas. There is little evidence of overall strategies or management of technological change, and most shipbuilding process innovation is adopted from abroad. While there is nothing wrong with copying or adopting technology, it must be done systematically and not haphazardly. Furthermore, drastic technological change, as introduced in many U.S. shipyards in the last two decades, requires structural and organizational change as well as effective training to be effective.

There has been no noticeable change in the way U.S. yards are organized, managed, and manned. This may in part be the result of the piecemeal introduction of technological change, though it could also be argued that the piecemeal change was induced by the lack of desire or ability to introduce organizational and management changes. This at a time when most major U.S. industries have introduced radical changes in their organization, management, and procedures. In these industries, job security and worker management collaboration has been introduced not only in quality circles or other work process oriented relations, but many industries have integrated the basic roles of workers and management.

Wherever unions resisted such changes they were usually the losers. U.S. union membership is now only 17% of workforce and expected to decline to 15% by 1995. Yet average annual salary increases by non-union labor has been 10% higher than that of union labor.

Another issue causing low productivity appears to be the U.S. shipbuilding approach to product development and marketing. Most ships constructed in U.S. yards are customer designed which often causes difficulties with efficient production or requires redesign for producibility. This not only causes added costs and addition of time, but may also result in undue numbers of unforeseen change requirements during construction.

Although these penalties are mainly assumed by the first ship of a series, later vessels suffer because of the resulting long time delay, which often causes built-in obsolescence in following ships, which in turn may induce clients to require a change to bring the vessel more up to date.

Marketing and selling mainly to the government also introduces various constraints which affect productivity and competitiveness. The industry has become used to doing business the government way. Its approach to cost estimating, material and equipment procurement, quality management, and production control are all affected by modeled after often archaic government procedures and requirements.

Marketing has also become highly politicized with many decisions and approaches to marketing and production based on political requirements and not technical and commercial considerations. These requirements are obviously also major causes for top heavy and less than effectively integrated shipbuilding management, excessive administration, and slow and often unresponsive control of shipbuilding progress.

The different causes and their contribution to low yard productivity

and competitiveness (or high cost of production) are:

1. casual labor practices and high labor turnover;
2. ineffective marketing, customer communications, long shipbuilding lead time, and customer control over design, and certain procurements;
3. ineffective, non-responsive, hierarchical organization and management structure;
4. comparatively low level of education and training of workers, staff and management;
5. lack of effective operational integration and intra labor as well as labor-management communications and cooperation;
6. inadequate yardwide strategic planning of technological change or piecewise technology introduction;
7. ineffective procurement and inventory management;
8. lack of total quality management;
9. restrictive union practices, such as work rules, seniority systems, and opposition to technological change, or changes in work procedures;
10. lack of effective design/production integration or design for producibility;
11. short horizon management; and,
12. lack of discipline, loyalty, and commitment by staff and workers.

It is interesting to note that Japaneseyards nearly doubled labor productivity since devaluation of the dollar against the yen, and therefore continue to be competitive in international ship sales. At the same time, relative productivity of U.S. yards has declined - they are today no more competitive than they were before the dollar devaluation against the major world currencies during 1987-89.

Only by drastic elimination of the above identified root causes will U.S. shipbuilding achieve world class excellence and productivity. Changes in the causes will have severe political repercussions, but we must harness the courage to face these.

This is not an easy task for an industry long sheltered from real competition by captive markets, government protection and direct as well as indirect government aids. But the reality of declining defense needs, unavailability of government subsidies, and increasing openness of world trade requires a reorientation of the industry if it is to survive and play its rightful role in the U.S. and world economy and defense.

POTENTIAL FOR U.S. SHIPBUILDING COMPETITIVENESS

What I propose is a radical overhaul and change of the structure, management, work rules, employment and business as well as marketing practices of the industry. Many may say that this cannot be done. Yet some of the most well known firms and industries in this country have done it or are in the process of doing it.

The U.S. automobile industry, which lost 29% of its domestic car market to foreign imports and cars made by U.S. based foreign automakers, has completely restructured itself, led by Ford and Chrysler. Their productivity in terms of cars produced per man/year or similar productivity measures has doubled in the last 4 years. It is still less than half that of their Japanese competitors, even those manufacturing their cars in the U.S., such as Honda, Toyota, etc., but they are well on the road of competitive improvements. Much larger improvements have been achieved by Boeing, Motorola, IBM, DEC, and scores of pharmaceutical firms. All of these have restructured radically.

The fact is that even with these major achievements value added per employee year in U.S. manufacturing is $90,000/employee year, still well the $198,00O/employee year achieved by Japanese manufacturers (1989). Unless we manage to close this gap, and it can no longer be done by currency exchange adjustments because the U.S. economic clout has eroded too greatly, U.S. standards of living and economic position will be endangered. Similarly, the survival of complete industries, such as shipbuilding, will be at stake. The outbreak of peace and an increasingly open unregulated world trading environment will

increasingly deflect support for maintaining non-economically justifiable industrial activities on the basis of national defense and economic security. But U.S. shipbuilding can be made competitive again, if there is enough will, commitment, and cooperation among all the stakeholders in the industry.

REQUIREMENTS FOR U.S. SHIPBUILDING EXCELLENCE

U.S. shipbuilding has to transform itself into a free enterprise, commercially viable world class competitive industry which is at the forefront of shipbuilding product and process technology and operates without dependence on and interference by government. It should evolve as an industry meeting world and not only U.S. defense needs, by independently developing advanced naval systems designed and produced wholly by the industry and not custom built to a client-developed design. Obviously client (U.S. and foreign navy) strategic and tactical requirements and specifications should be considered, but the industry should respond to these by developing responsive systems themselves, and not build to navy designs, which often evolve over an undue long time, with built-in obsolescence, and are often difficult to produce without major design modifications. At a time when complex military aircraft, missile, ground warfare and other military systems are designed by their manufacturers, there appears little need for navy (or navy contractor) design of naval ships.

Shipyards should develop designs for naval ship markets which they are best equipped to deliver. Designs thev can effectivelv build and themselves arrange for all procurement. The government may provide research and development (R&D) assistance for the development of new naval ship and/or payload systems, but should not itself perform (or guide) systems development and design. Shipyards would maintain close contact with their customers and assure up-to-date knowledge of their future technological requirements, quality and performance needs, and prospective naval ship systems demand.

It is important for yards to maintain control over all stages of the product (naval ship) and production development cycle. When completely new naval ship or ship systems technology is to be developed, then a joint shipbuilding industry research project (much like those in the TV and computer industry) should be undertaken with joint government/industry support, in which all relevant resources and capabilities are pooled. Similarly in commercial shipbuilding, yards should develop their standard products (ship designs) equipped with standard outfit suites and machinery. They should market these standard designs with as few options or extras as possible and arrange for efficient just-in-time delivery of all procurement or buy-in items and services. This will allow yards to reduce order to delivery time, procurement and inventory costs, and finally improve productivity and quality. It would also allow yards to specialize in ships or products most efficiently and effectively built in their facilities.

It furthermore would permit yards to be involved in ship technology development which is a prerequisite for effective ship production technology development and use.

U.S. shipyards are distinct in their lack of involvement in basic ship design and technological developments. Designs and engineering affect productivity, quality, and costs. Design affects material choice, method of processing, joining, forming, machining, assembly and outfit and, as a result, locks in all important decisions affecting productivity, schedule, quality, and costs.

In fact, design, engineering marketing, production, procurement, and management must be effectively integrated with workers and staff involved in all functions or at least rotated through these various activities to assure more effective understanding and cooperation as well as quick resolution of problems.

To achieve this, the hierarchical type organizational structure used in U.S. shipyards may have to be radically changed, flattened, and made more flexible, to allow better communications, more effective decision making and greater flexibility of operations under continuously changing conditions.

This obviously also implies new open, trusting labor-management relations, job security, profit sharing, effective recognition, and other motivating inducements. As a result, unions or the union will have a completely different role. Its function will be to help coordinate labor management relations and assure that the joint interest of labor and the yard is 'always recognized and

maintained. Unions must also play a greater role in motivating their members and assuring responsiveness as well as discipline.

Shipyards should invest more in training and attempt to hire more highly educated workers and staff. Shipyard training must become a continuous process by which worker's and staff's technological abilities are advanced all the time.

U.S. shipyards should require strict schedule and delivery adherence to assure that all possible conflicts are resolved before the start and minimize or eliminate changes in design, material, equipment, supplier or other.

Over 30% of the cost difference between U.S. and Japanese yards, for example, is caused by change order, late supply delivery, or other schedule delay and the resulting loss of productivity. If inventories in U.S. yards could be. reduced to an average of one month requirements (versus 6 days in most Japanese yards), if deliveries enforced voluntary or client-imposed change orders were eliminated, and the schedule tightened, then over 48% of the time to delivery could be saved, and delivered costs reduced by 30%, of which about 12% would be reduction in construction cost financing and 18% saving accruing from reduced inventory holding costs and improved productivity (Ref. 1).

To verify these numbers we use Japanese shipyard cost and performance figures, and computed the increase in costs if a Japanese yard were to operate with the same long inventory, unreliable procurement deliveries, large numbers of change orders, etc., or in other words, the conditions currently by typical U.S. yards.

To achieve excellence U.S. yards have to introduce technological change in management, production, marketing, and engineering in a systematic and piecewise manner. Computer Aided Design/Computer Aided Manufacture (CAD/CAM) flexible manufacturing, quality circles, and other recent developments do not achieve their promise unless introduced together with changes in institutional structure, delegation of authority, improved communications, motivational incentives, integrated marketing design, and engineering, worker and staff discipline, new process technology, etc. Similarly quality cannot be achieved by isolated quality control or quality circles. Quality must be a total commitment involving all activities of the yard.

As mentioned before, other U.S. industries have turned around and achieved total productivity improvements of 2-3% Per month. The same is possible in U.S. shipbuilding with courageous commitment to change. There is nothing wrong with U.S. labor or management. As individuals, we perform as well as the best. It is the way our shipbuilding industry is made to work which is to blame.

Our lack of productivity is not the result of individual incompetence or lack of ability at all levels in a shipyard, but the accumulation of factors which together do not permit individuals, facilities, processes, etc. to perform at their full capacity and to the best of their ability. A worker without adequate tools, materials, or direction cannot perform his job. Our industry suffers under a consistent hangover of factors which do not allow it to perform at its best. We need a radical change to provide us with that opportunity.

GUIDELINES FOR A WORLD CLASS U.S. SHIPBUILDING INDUSTRY

A number of guidelines or goals are suggested which are designed to move U.S. shipbuilding to a state of a world class industry. Such guidelines, to be effective, must be followed all together, as piecemeal introduction would not serve. These guidelines complement and support each other towards the achievement of radical improvements in productivity, cost, and market share.

(1) People are the most important factor of production. Technology can give them better tools but ultimately people determine output. People affect product and productivity and ultimately profit (P.P.P.). People must be motivated. Recognition, reward, and appreciation are necessary to motivate people. People in a yard must understand all the functions of the yard, the needs of the customer, the role of the product. People must be proud of their association with the yard and the products of the yard. They must have a feeling of belonging, contribution, and security. they must be given all opportunities for training, communication, and advancement - Total Employee Involvement.

(2) Management should be organized to reflect decision requirements and not meaningless

hierarchy. Management serves workers and is there to facilitate their work and not the other way around. Technological and other changes should be suggested by the users of technology and not the managers. Management has responsibility for strategic improvements.

(3) Workers and managers all have to be involved in selling and in customer understanding and relations. Similarly, quality is defined by the customer, but quality requirements must be imposed on design, engineering, suppliers, manufacturers, etc. Total quality management improves productivity as it reduces waste in all the different activities.

(4) Inventory is waste and must be kept to a minimum. Inventory does not improve process or resource utilization, but only covers up ineffective scheduling, line imbalance, and other ineffective management. Improved total quality, effective scheduling, just in time supplies, and resulting low or zero inventory will also greatly reduce scrap.

(5) Production time must be compressed to a minimum to

a. maximize resource utilization;
b. reduce in process (construction) financing cost;
c. minimize built in obsolescence;
d. reduce scrap and other waste;
e. assure achievement of quality;
f. maintain technological advance at highest level; and,
g. achieve maximum total productivity, highest profit, and largest market share.

Wasted time or time delay caused by scheduling, late deliveries, change orders, lack of management or worker discipline, or other will have multiplying effects on productivity and cost.

(6) Supplies should be single source and suppliers included in the total product development, as well as quality and production schedule management.

(7) Use of integrated product and manufacturing design teams consisting of sales, design, engineering, manufacturing, and management staff should be encouraged.

(8) Maximization of concurrent design, engineering, and process development and feedback learning.

Reduction of bureaucratic bottlenecks by limiting data collection, transfer and storage to that actually required. Train all people in basic statistical methods for self-evaluation of performance and quality.

Achievement of these goals requires commitment from top management which must convince staff and workers that these goals are irreversible, will benefit all, and that benefits will be shared by all.

RECOMMENDATIONS AND CONCLUSIONS

It is not possible to spell out a detailed plan in a short paper, and therefore an attempt was made to only identify the issues, illuminate the opportunities, and define some essential goals which could revitalize the U.S. shipbuilding industry. Improvements in total productivity of 2-3%/month are achievable, as are development of new product (ship) and production process technology. The U.S. has introduced the most advanced ship technology only to have others benefit from it.

It is necessary for us to emerge from our sheltered parochial (and often paranoid) position and assume a can-do and prideful pose. There is no reason why U.S. shipbuilding cannot effectively compete in world shipbuilding if we set our mind to it, ignore the past, and work toward the future, with commitment, price, hard work, courage, and imagination.

Most important, the U.S. shipbuilding industry will have to be more commercially oriented and loose its obsession for government aid, support, and contracts. The industry not only spends an inordinate amount of time and money on government relations and political support, which if spent on product development, marketing, and restructuring may go a long way in making it commercially competitive. Dependence on the government budgeting process results in major instability while reducing the industry's leverage with labor.

The U.S. shipbuilding industry is an anathema in today's free enterprise world where industries

worldwide move rapidly from dependence on government decisions and government generated business. The U.S. shipbuilding industry can become commercially competitive, given its capability.

A five-year transition period may be required to restructure the industry. One possibility to facilitate this transition would be to create a Shipbuilding Capital Corporation, a joint government-industry group backed by a federal loan guarantee of say $2 billion, which would develop:

(1) a new organizational and business structure for the U.S. shipbuilding industry;

(2) perform advanced ship and shipbuilding concept research;

(3) design several American standard ships of the future;

(4) restructure the U.S. shipbuilding supply system;

(5) retrain shipyard managers and workers; and,

(6) develop effective strategies for marketing U.S. shipbuilding worldwide.

The loans would be repaid from license fees, royalties, sales commissions, and so forth.

Unless we move in this general direction, I feel that the future of the industry is dim indeed, as we cannot rely on a continuous and adequate flow of navy work nor effective government support in the future.

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